

# Comprehensive Fishery Research Program

## Research Components

The Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) mandates strong action to conserve and manage fishery resources that contribute to the food supply, economy, and health of the Nation. MSFCMA provisions require NMFS to end overfishing, rebuild all overfished stocks, and conserve essential fish habitat through research and consultations on Federal and state actions that may adversely affect such habitat. These are among our primary stewardship responsibilities.

NMFS is responsible for ensuring that management decisions are based on the highest quality scientific information on the biological, social, and economic status of the fisheries. Biologically, this includes species' responses to environmental changes, exploitation, and other human activities that affect them and their habitat. This information includes social, cultural, and economic behaviors and incentives that influence human/marine interactions. All of the agency's information must be comprehensive, objective, credible, and effectively communicated. It is used not just for current management decisions, but also to conserve resources and anticipate future trends, assure future utilization opportunities, and assess the success or failure of the agency's management efforts.

NMFS is also responsible for ensuring that this information, and thus the management decisions for which it provides the foundation, is understood and its validity accepted by user groups and other constituents. To accomplish this, the MSFCMA has mandated that we provide a role for commercial fishers in our fisheries research.

The research priorities of NMFS may be grouped into the four major areas with several sub-areas defined by Congress (see **Legislative Background**):

- I. Research to support fishery conservation and management**
- II. Conservation engineering research**
- III. Research on the fisheries**
- IV. Information management research**

### **I. Research to support fishery conservation and management**

Living marine resources (LMRs) currently support extensive commercial, recreational, and subsistence uses. In 2000, commercial landings by U.S. fishers were 9.1 billion pounds valued at \$3.5 billion. The 2000 U.S. marine recreational fish catch was an estimated 429 million fish, taken on an estimated 76.0 million fishing trips (NMFS, 2001). These represent just some of the many benefits Americans derive from living marine resources.

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However, many marine species are under stress from overexploitation or habitat degradation, or both. Over one-third of all fish stocks for which we have scientific population information are overutilized, and nearly half are below optimal population levels. Some populations are in danger of extinction, and many more are threatened by various human activities. There are many other species about which we have little information. Many factors, both natural and human-related, affect the status of fish stocks and their environment.

NMFS scientists are actively engaged in collaborative research to protect and enhance fishery resources. These research efforts include mapping, spatial analyses, geographic information systems (GISs), and fishery and ocean habitat modeling and characterization, as well as an evaluation of ecosystem approaches focusing on spatially-explicit models and further research into trophic relationships. Additionally, with the increasing need to seek new management approaches to enhance and conserve essential fish habitat (EFH), NMFS is conducting studies on adaptive/management techniques through the identification and use of potential areas of refugia (i.e., using areas closed to fishing activities for both recovery and research) and experiments on no-take and limited take zones and time-area closures. NMFS is also exploring the research potential of MPAs to facilitate important experiments in marine ecology and to support recommendations made by the NRC (NRC, 2001). Further, NMFS is evaluating the potential negative/positive impact of fishing gear on habitat and fisheries production.



NMFS scientist receives instructions prior to launch of the *Deepworker* submersible in preparation for survey on deep-water fishes and their habitats in and around the Big Creek Ecological Reserve off California.

NMFS' research efforts incorporate the use of innovative new technologies and techniques. For example, NMFS, in cooperation with NOAA, is working to enhance survey capabilities through research and development of an omnidirectional hydroacoustic system. This new system will combine biomass assessments with the ability to acoustically identify species, utilizing airborne LIDAR (light detection and ranging) laser technology as a biomass assessment tool for near-surface pelagic species, and using underwater (laserline) technology for identification of habitat types and species identification. Additionally, NMFS employs manned submersibles and remotely-operated vehicles to directly evaluate deepwater species and their habitat.

It is NMFS' responsibility to provide fishery managers with the information needed to make scientifically sound decisions. In order to support fishery conservation and management, NMFS scientists are actively pursuing the following areas of research.

## **I.A. Biological research concerning the abundance and life history parameters of fish stocks**

Activities in this area include collecting catch and effort data, biological sampling, and developing bio-statistical analyses for a variety of fishery management plan (FMP) and non-FMP species of exploited fish and invertebrates. Fishery-dependent and fishery independent (i.e., resource survey) sources provide age and size samples, catch composition, and indices of relative abundance. These data

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are key inputs to stock assessments, fishery management regulations, and the production of status reports for living marine resources and their fisheries.

The complexity of any assessment is determined by the amount of available data (i.e., tiers of data completeness) and by the type of information required for scientific advice to fishery managers. Stock assessments can be roughly grouped in order of increasing levels of modeling effort and sophistication, each one incorporating the underlying data requirements of all preceding levels.

### Assessment Levels:

- **Index Only:** a time series of relative index of stock abundance calculated as raw or standardized catch-per-unit-of-effort (CPUE) in commercial, recreational, or survey vessel data; or a one-time estimation of absolute abundance derived from tagging results, a depletion study, or some form of calibrated survey.
- **Simple Life History Equilibrium Models:** typically applied to life history information; for example, yield-per-recruit or spawner-per-recruit functions based on mortality, growth, and maturity schedules; catch curve analysis; survival analysis; or length-based cohort analysis.
- **Aggregated Production Models:** data input for equilibrium and non-equilibrium production models aggregated both spatially and over age and size classes; these include the classic Schaefer model and the Pella-Tomlinson model.
- **Size/Age/Stage Structured Models:** techniques that include cohort analysis, virtual population analysis, age-structured production analysis, CAGEAN, stock synthesis, size or age-structured Bayesian models, modified DeLury methods, and size or age-based mark-recapture models.
- **Ecosystem Models:** assessments incorporating ecosystem considerations with spatial and seasonal analyses. Ecosystem components include one or more of the following: (1) one or more time-varying parameters, either estimated as constrained series, or driven by environmental variables; (2) multiple target species as state variables in the model; or (3) living ecosystem components other than target species included as model variables.

The biology and life history of species have become more significant with respect to management of the Nation's living marine resources. Describing and understanding migration and distribution patterns, habitat use, age, growth, mortality, age structure, sex ratios, reproductive biology, and responses to environmental variability are key to developing harvest strategies that produce high yields at low risk to the long-term sustainability of the resource base. A variety of scientific methods are employed, including aging using otoliths, histological analyses of gonads, food studies, and observations of spawning behavior. Studies of early life history and fishery oceanography are necessary to understand recruitment dynamics, with the aim of predicting incoming year-class strength. There is an in-



NMFS scientist examines the stomach contents of Alaskan walleye pollock.

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creasing need to identify and characterize discrete stocks. This will enable scientists to correctly structure stock assessments and design stock-specific management measures.

### **I.B. Social and economic factors affecting abundance levels**

NMFS also recognizes the social, cultural, and economic diversity of the fisheries, and the importance of recognizing those differences in creating effective conservation measures. For instance, one critical factor affecting stock abundance is the level of fishing effort. Type and location of both commercial and recreational fishing effort vary across different fishing fleets, groups of anglers, and communities. Also, these groups will differ in their responses to alternative strategies of effort control such as days-at-sea, closed areas, limited access, and bag-limits. NMFS will need new data and models, and modifications to existing models, to capture fully this diversity and its interaction with biological diversity.

NMFS will therefore develop bio-socio-economic models and increase the collection of data necessary to meet conservation goals and maximize net economic and social benefits to the Nation from living marine resources. For commercial fishing, these data include vessel and plant level cost and earnings data; ex-vessel prices; and data on social and institutional constraints such as open access regimes or differing ethnicity-based labor practices. For recreational and subsistence fishing, these data include information on expenditures, trip characteristics, demographic descriptors, and social and cultural influences on fishing behavior. Given that some of these data are newly emphasized, national coordination and funding of these activities will be especially important.

Coordinated bio-socio-economic research and analysis will add the element of human behavior to stock variability, thus bringing the parameters of our models closer to real world conditions. This, in turn, will improve the predictive power of stock assessments and incorporate fishers' incentives into the precautionary approach.

### **I.C. Interdependence of fisheries or stocks of fish**

Living and non-living parts of an ecosystem are linked to each other through physical and biological relationships — for example by food chains or shared habitat use. This information is very important if we are to successfully manage our living marine resources in a holistic manner. The health of a fish stock and the merits of alternative harvest strategies cannot be determined in isolation; an ecosystem-based approach is needed to take into account the various factors that affect the status of a stock and the importance of a stock to other components of the ecosystem, as recommended in a report to Congress (EPAP, 1999). The abundance, productivity, and spatial distribution of a fish stock depends on a number of factors, including environmental conditions, habitat quantity and quality, the abundance and health of its competitors, predators, and prey, as well as its symbiotic relationships.

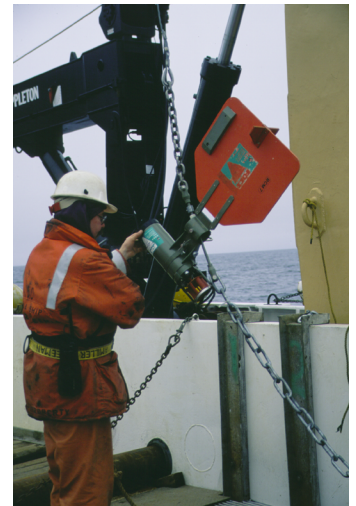
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The objective of the biological studies on ecosystem interdependence is to understand the functional relationships among ecosystem components. To do so requires that we determine consumption rates and the functional form of feeding interrelationships of fish as well as the spatial and temporal variability in abundance and habitat use. We will develop recruitment and multi-species models that incorporate food web and environmental information. The models can be used to help predict long-term impacts of various harvest strategies and environmental trends on yield potential and species composition, as well as to investigate effects of predation and compensatory population mechanisms on long-term stability, production, and structure of fish communities under different harvest strategies and environmental regimes. Research activities include the following:

- Marine food web research through field and laboratory studies of fish consumption rates, feeding selectivity patterns, food preference, and nutritional values of various foods.
- Density-dependent and predator-prey dynamics.
- Fisheries oceanography research to determine how varying environmental conditions create variability in biological components of the ecosystem.
- Food-web-based dynamic mathematical models to examine how abundance of fish stocks, marine mammals, and other ecosystem components react to changes in environmental conditions and alternative fishery management measures.

To examine human activities in an ecosystem perspective, research is required on the behavior of consumptive (e.g., commercial and recreational fishers) and non-consumptive (e.g., whale watchers and non-harvest divers) users of the resource. Some fishers target a single species or species assemblage exclusively. Others fish for a variety of different species by season (an annual round), sometimes switching fishing gears to do so. Yet other fishers are part-time participants only, working in land-based occupations for some portion of the year. Other users of the ecosystem who, for example, swim with sharks or view coral reef communities, benefit from a rich and diverse habitat. Still others who never see the resource value knowing that it exists.

Different fishing behaviors, based on the use of different gear types or vessel sizes among commercial or recreational fishers, appear more likely to interact with the ecosystem differently and can negatively impact the net benefits the ecosystem generates for a non-consumptive user group. These different behaviors and the relative values attributed to the ecosystem by different user groups imply different levels and types of fishing effort applied to a resource stock and have differing effects on their various target species, and are therefore important to ecosystem management. For example, the development of a wetland for industrial or residential purposes may impact water quality and thus require that a water treatment plant be constructed to replace the wetland's natural filtering action, so that an offshore coral reef is preserved. Some critical research areas include:



A current meter (an instrument that measures current, temperature, conductivity, and pressure) is recovered by an operations specialist aboard the R/V *Miller Freeman* from a sub-surface oceanographic instrumentation mooring deployed in the Bering Sea by FOCI/PMEL in support of Steller sea lion habitat studies.

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- The suite of fishing and non-fishing activities available to commercial and recreational fishers for which they are qualified.
  - The geographic range within which various consumptive and non-consumptive user groups operate.
  - The identification of all user groups, including but not limited to consumptive and non-consumptive as well as those that value the existence of the resource.
  - Determination of the existence value of fishery resources in the ecosystem by habitat type.
  - Determination of the non-market value of fishery resources in the ecosystem by habitat type for recreational and other non-consumptive user groups.
  - Determination of the market value of fishery resources in the ecosystem by habitat type for commercial and other consumptive user groups.
  - Determination of the market incentives that direct behavior by consumptive and non-consumptive user groups.
  - Development of models that incorporate ecosystem relationships into bio-economic models.
  - Identification of the demographic, sociological, and anthropological characteristics of different user groups who value fishery resources and how they differ between groups.
  - The effect of point and non-point specific sources of pollution on the ecosystem to determine trade-offs in costs and benefits of improving ecosystems; e.g., hypoxia in the Gulf of Mexico.
  - Establishment of safe minimum standards for fishery and other resources in the ecosystems.
  - Identification of the role of coastal settlements on ecosystems and stocks of fish.
  - Identification of the role of ecosystems and stocks of fish on communities.
  - Determination of the interactions and links between user groups and fish stocks.
  - Establishment of a national bio-socio-economic panel of experts to advise NOAA and NMFS on ecosystems, habitat, fish stocks, and their interdependence with all affected user groups.
  - The amount and value of subsistence, recreational, and part-time fishing.

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## I.D. Identifying, restoring, and mapping of essential fish habitat (EFH)

The long-term viability of living marine resources depends on conservation and protection of their habitat. The effects of habitat degradation are often insidious, and some losses are not well understood. Others, however, are apparent. We know, for example, that dams for hydroelectric power generation and water diversion for agriculture have severely reduced some valuable anadromous fish runs, and chemical contaminants cause neoplasm and reproductive dysfunction in fish (e.g., winter flounder in Boston Harbor and English sole in Puget Sound). We also know that habitat changes in Florida Bay and Chesapeake Bay have resulted in continual changes in fish communities, and that environmental variability, such as El Niño, changes the latitudinal distribution, abundance, and recruitment dynamics of several species on the west coast. It has become apparent that many changes to the habitat are not only the result of natural processes, but also the direct result of human interactions with the environment.

The Sustainable Fisheries Act of 1996 requires fishery management councils (FMCs) to describe and identify EFH in FMPs, to minimize to the extent practicable adverse effects of fishing activities on such habitat, and to identify other actions to encourage the conservation and enhancement of such habitat. It also requires that the Secretary of Commerce initiate and maintain related research. MSFMC defines EFH as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. For the purpose of interpreting the definition of EFH: ‘waters’ include aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include aquatic areas historically used by fish where appropriate; ‘substrate’ includes sediment, hard bottom, structures underlying the waters, and associated biological communities; ‘necessary’ means the habitat required to support a sustainable fishery and the managed species’ contribution to a healthy ecosystem; and ‘spawning, breeding, feeding, or growth to maturity’ covers a species’ full life cycle.” (Federal Register, 2002) .

NMFS will continue to conduct research, analyze data, and provide consultation necessary to: (1) identify estuarine, coastal, and oceanic habitats and their utilization by various life stages of living marine resources for spawning, growth, and production, through comparative studies of similar habitats in stressed and unstressed environs as well as comparative studies of different habitats; (2) document the life history of managed fish and determine factors that influence resiliency or sensitivity to fishing; (3) increase NMFS’ understanding of the role of the benthic community in the overall ecosystem, the interaction of target fish with benthic communities, and effects of fishing on benthic communities; (4) determine the best methods for restoring LMRs injured by human impacts including harmful spills, vessel groundings, material disposal, and fishing; (5) develop population and habitat recovery models; (6) describe seasonal changes in the character of the water column and seabed, mega-invertebrates, and benthic infaunal communities in estuaries and nearshore waters; (7) map EFH using remote sensing platforms (satellite, aerial, and acoustic) along with ground truth and algorithm



NMFS scientist uses a transmission electron microscope to study the bioaccumulation of chemical contaminants in fish.

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development to assess habitat type and quality and environmental parameters such as temperature, turbidity and salinity; and (8) work cooperatively with fishers to gain information on existing fishery habitats. The information resulting from these activities will be used by fishery managers to identify, describe, conserve, and enhance EFH.

The NMFS Centers' staff work closely with Regional Offices, FMCs, NOS research facilities, the NOAA Damage Assessment and Restoration Program, and other Federal and state agencies to provide timely habitat information. NMFS works with the NOAA line offices and other agencies in developing the Coastal Change Analysis Program and Coastwatch to apply satellite imagery and aerial photography to habitat mapping, analysis of change in coastal land cover, and assessment of water temperature, color, and circulation.

These research areas and the specific EFH research described for each Fishery Science Center will be used by NMFS and the FMCs to:

- Develop a comprehensive and coordinated base-funded habitat research program in NMFS that interacts with and provides information to habitat managers, the FMCs, and the Offices of Science and Technology, Sustainable Fisheries, Habitat Conservation, and Protected Resources.
- Improve understanding of the distribution and habitat requirements of early life stages of managed species and their prey species.
- Improve stock assessment capabilities and reduce uncertainty.
- Improve habitat conservation, protection, and enhancement capabilities and improve assessment of threats to EFH and managed fishery stocks.
- Evaluate and predict how environment and climate signals change the distribution and amount of EFH for important stocks.
- Synthesize research information needs nationally and prioritize habitat research and funding across regions to refine EFH identification, assess and minimize adverse effects of fishing activities, and identify actions to encourage the conservation and enhancement of such habitats as required by the MSFCMA.
- Develop a national database on habitat restoration measures and designs that enhance recovery of biodiversity and value to fisheries.
- Map EFH for managed species in each region, and develop a national GIS database on essential habitat.
- Provide GIS identification and mapping of habitat subject to adverse impacts from fishing gear.
- Restore degraded habitat using restoration options that have a scientific base.

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- Cooperate with fishers in gathering information on habitat.
  - Research current incentives for habitat protection, including literature reviews of incentives for non-fishery activities such as land-based non-point-source pollution.

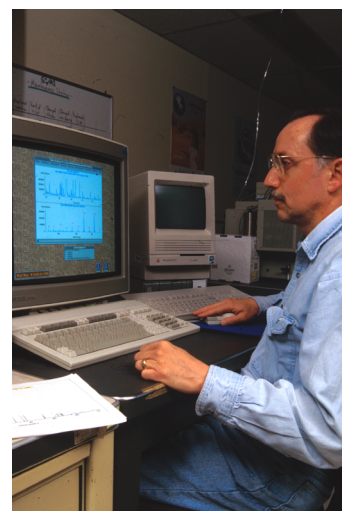
## **I.E. Impact of anthropogenic factors and environmental changes on fish populations**

Changing conditions of the biotic and physical environment occupied by fish, whether natural or anthropogenic, affect population productivity through mechanisms ranging from sub-lethal effects to outright mortality. Detecting such changes is an important task, but determining causal relationships is complex. Anthropogenic effects may be confounded by natural environmental changes or cycles. NMFS must conduct research to unravel these complex relationships and better understand their role in the sustainability of marine fish populations.

There is recognition in the scientific community that toxic contaminant discharges to the coastal oceans can have a significant impact on the viability of important fish populations. Contaminants can disrupt an organism's early life stage development and growth that in turn can affect their reproductive potential as adults. Such nonlethal effects are not easily identified or characterized, and therefore, are difficult to relate to the sustainability of the fishery populations. The quantification and identification of deleterious changes is further complicated by natural and uncontrolled variability within and between fishery populations and their supporting food webs.

NMFS will continue to study the potential effects of contaminants on important fishery species as well as the sources of variability. To assess the risk to fish populations from different combinations of stressors there must be a linkage made between understanding toxic effects of contaminants to individual organisms and the factors, both anthropogenic and natural, that influence fishery populations. There has been growing recognition that marine pollution can disrupt the development and function of the reproductive, endocrine, immune, and nervous systems of marine animals, including fishes, affecting reproductive and growth processes critical to population stability. Because the effects are not always immediately visible, it is difficult to establish the impact on fish populations. Environmental variation at different temporal and spatial scales further complicates the picture. NMFS will continue to study similar habitats in stressed and unstressed anadromous streams, estuarine, and ocean environs in order to understand the effects of pollution on LMRs and their habitats.

NMFS will also research social and economic causes of habitat degradation, from fishery and non-fishery sources. This research includes coordination with researchers studying land-based activities such as non-point source pollution and urban development. NMFS also engages in research to determine the effects of long-term changes in the ocean climate on LMRs. This information helps assess the true impact of human-induced factors.



NMFS scientist in the Biochemical Effects of Contaminants Laboratory, NWFSC, uses a PhosphorImager to analyze DNA damage in fish exposed to environmental chemical carcinogens.

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Habitat loss and degradation affects riverine, estuarine, and coastal ecosystems. The primary threats come from physical destruction of wetland and other habitats, alteration of freshwater flows, eutrophication, and destructive fishing methods. For example, logging contributes to siltation and can destroy salmon spawning habitat upriver and impede their migratory paths. Construction of marinas and docking facilities as well as dredging and the disposal of dredged material in estuaries and bays also cause significant habitat impacts. Loss of aquatic habitat (e.g., coastal wetlands or seagrass and kelp beds) resulting from development adversely affects a variety of food webs that are important to adults and juveniles of many marine and anadromous species. Propeller damage to shallow vegetated and non-vegetated habitats not only causes a direct loss of habitat, but results in destabilization of these areas, resulting in increased habitat loss and increased sediment re-suspension and turbidity. Diminution in freshwater volume and flow rates stems from damming and diversions of major rivers, impacting nearshore ecosystems adapted to seasonal discharges of freshwater. Destructive fishing methods can damage EFH and coral reefs.

Nutrient enrichment and eutrophication have a major impact on fish populations in estuarine and coastal waters. This impact is manifested by hypoxia/anoxia accompanying the death of phytoplankton populations (Gulf of Mexico dead zone off the Mississippi River and western Long Island Sound) and loss of inshore habitat (replacement of eelgrass beds by macroalgae or loss of eelgrass beds due to shading by epiphytes or phytoplankton in Chesapeake Bay, Waiquiot Bay, and Lake Pontchartrain). In addition, changes in nutrient dynamics can create harmful algal bloom events that can lead to wild fish kills, shellfish harvest closures, and mass mortalities of farmed salmon in the Northwest. Fishing activities, if they alter food web structure, could change the population dynamics of harmful algal species. A change in trophic webs that decreases grazing on phytoplankton is a major factor in many blooms leading to more or longer lasting bloom events. The potential effect of climate change on harmful algal blooms events is also not known.

NMFS will engage in a variety of research initiatives to study the effects of natural and man-made environmental changes on living marine resources and the related ecosystem, social, and economic causes and effects, including:

- Examining the effects of mobile fishing gears, such as bottom trawls, which disturb the sea bottom and damage fragile corals and other benthic habitat.
- Determining the cumulative effects of watershed and regional land cover and changes in that land cover on EFH.
- Ecosystem monitoring for habitat degradation and resource surveys by satellite remote sensing and shipboard and moored instrumentation.
- Developing rationales/methodologies to detect and quantify habitat loss.
- Establishing a GIS database to document and track habitat loss.

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- Researching natural environmental variability at temporal and spatial scales pertinent to marine fish populations.
  - Developing methodologies to detect and quantify the effects of habitat alterations on fishery populations.
  - Conducting laboratory and field research to identify the probable results of contaminant inputs and habitat alterations that significantly affect important fishery species.
  - Developing molecular genetic techniques to assess the fitness of fishery organisms.
  - Developing models (descriptive and predictive) to assess the risk posed by contaminants and habitat alterations to fishery populations.
  - Analyzing and synthesizing existing environmental and fishery data that are available on fishery habitat types and fishery populations.
  - Researching to separate the effects of natural versus human-induced climate change.
  - Developing methods to identify, map, and forecast harmful algal blooms.
  - Determining the effect of fishing on ecosystem trophic structure and population dynamics of harmful algal species.
  - Cooperating with fishers in assessing habitat changes over the past decade.
  - Assessing current economic and social incentives for habitat protection or degradation.

## II. Conservation engineering research

Conservation engineering research is intended to make fishing gear more efficient by decreasing fishing costs, bycatch mortality, and habitat destruction. It is also intended to improve the data provided by scientific surveys of fish populations. This area includes research on gear performance and fish behavior used in the development of selective fishing gear to reduce bycatch. Bycatch is responsible for the death of millions of juvenile finfish, including red drum, red snapper, weakfish, Spanish mackerel, and king mackerel. For example, prior to the implementation of bycatch reduction devices (BRDs), it has been estimated that between 15 to 50 million red snapper were annually taken and discarded in the offshore shrimp fishery in the Gulf of Mexico. The Food and Agriculture Organization (FAO) estimates that one-third of the world's 16 billion lbs. of bycatch comes from shrimp fishing. The most recent studies of bycatch estimate that the ratio of bycatch to shrimp landed is 4:1 in the Gulf of Mexico. The worldwide bycatch ratio for all fisheries is 0.35 lb to 1 lb. of target species.



NMFS contract workers examine the contents of marine mammal scat collected in Alaska, AFSC.

Since few discarded fish from trawls survive, bycatch constitutes a problem for fishery managers because it represents both an unaccounted mortality in fisheries and an economic loss to harvesters and the Nation. For instance, fishers in another fishery might target the discarded species, or fishers in the same fishery might be able to keep those same fish when they are older or larger. Recreational discards are another source of fishing mortality. Information is needed to determine proportions of discards in different recreational fisheries and assess associated release mortality. Additionally, NMFS will encourage research on ways to increase the survival of recreational releases. Bycatch reduction, then, is critical for the continued existence of healthy fisheries, and is especially critical when the bycatch includes protected species. Additionally, NMFS conducts research at several of its laboratories on populations of ESA-listed species and marine mammals. Stocks of listed species and marine mammals interact with species managed under the MSFCMA (e.g., competition for food, bycatch). As such, research conducted to support requirements of the Magnuson-Stevens Act also make an important contribution to the conservation and management requirements of the Endangered Species Act (ESA) and the Marine Mammal Protection Act (MMPA). Along with incentives and other management strategies, one solution to bycatch reduction is to design and operate selective fishing gears, using knowledge of species behavior, gear hydrodynamics, and fishing practices.



NMFS observer measures a dogfish.

An important data collection method used by NMFS to conduct research on fishing gear and its impact on fish stocks, protected species, and habitat, is the deployment of marine resource observers on commercial and recreational fishing vessels. Observers collect information on all aspects of fishing gear operations, including what kind of gear is used, how it is set, how long it is set, and how it is retrieved, as well as information on fish catch and bycatch and incidental takes of protected species. Observers also collect life history data on species of concern, collect biological samples, and support research through tagging of released animals and other activities. Observer data provide information for stock assessment research, for the assessment of gear efficiency, and for monitoring the relative impacts of various types of gear and fishing methods on fish and protected species and marine habitats. Currently, observers are deployed in only a fraction of the U.S. commercial and recreational fisheries managed by NMFS or required to be monitored under the MMPA, but there are initiatives underway to expand the observer program into more fisheries and to more fully integrate observers into fisheries research activities.

Bycatch levels and control measures continue to occupy the attention of most fishery management actions of all regional FMCs. Even when apparent solutions are found, the dynamics and abundance of marine species change in time and area, which can shift the character of the problems and require continuous adjustments to their solutions. NMFS will continue to conduct studies to determine the magnitude of bycatch of overfished stocks and options to reduce it. The options may require the design of new types of fishing gear that are more selective for the targeted species. This approach is known as “conservation engineering” and NMFS will work in cooperation with the fishing industry and gear manufacturers to find designs that meet conservation needs while recognizing the financial constraints of fishers.

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To determine when gear modifications are the most appropriate response to bycatch problems, NMFS will study existing programs such as the turtle excluder devices (TEDs) in the Gulf of Mexico and BRDs to exclude finfish from Gulf shrimp trawls and from northern shrimp trawls in New England. By understanding the successes and setbacks in these and other settings, NMFS will be better able to coordinate gear research with the social, economic, and institutional constraints of specific fisheries.

Experimental work with selective fishing gear involves considerable field work on board fishing vessels working under actual fishing conditions. Most trawl gear evaluation includes an alternate tow approach, varying which net is fishing with the experimental gear and comparing the catch results using statistical tests. Underwater cameras allow for examination of the behavioral mechanisms and gear variations that would account for the catch differences.

Growing controversy over the impact fishing gear is having on EFH has resulted in a need to evaluate the impacts. Effects from fishing may include physical disturbance of the substrate, and loss of and injury to, benthic organisms, prey species and their habitat, and other components of the ecosystem. Experiments are being designed to assess the potential effects of all fishing gear types used in waters described as EFH. These studies will include the use of remote underwater cameras, divers, abundance studies, and perhaps research closure areas for comparison. If an adverse effect is identified and determined to be an impediment to reaching target long-term production levels, then the research needed to quantify and mitigate that effect would be the next logical step.

Growing concern over the impacts of bycatch on stocks resulted in the development of a NMFS Bycatch Plan (NMFS, 1998a). Agency experts with experience in fishery management, stock assessment, and social sciences compiled this plan. It includes proposed national bycatch objectives, specific recommendations concerning data collection, evaluation and management actions necessary to attain the objectives, and a comprehensive assessment of the state of bycatch in the Nation's marine fisheries. The latter is intended to serve as a benchmark from which progress in bycatch reduction can be measured.

NMFS is committed to maximizing the research contribution of the fishing industry and other non-government participants in the fisheries. Across the NMFS regions, the industry is providing advice in research planning, in formal reviews of research programs, and, where possible, in research operations. Examples of research involvement includes: (1) provision of chartered vessels and crew for surveys and bycatch gear development; (2) keeping logbooks of species catches, including bycatch; and (3) industry efforts to develop gear, gear modifications, and fishing practices to reduce bycatch.

The Saltonstall-Kennedy Grant Program has had direct industry involvement and investment since its inception decades ago. Industry members submit proposals, usually with strong cost sharing, to conduct research in conservation engineering, to develop fisheries for underutilized species to relieve pressure on traditional species, and to improve the after-catch utilization of nearly all species.



NMFS gear specialist prepares test nets for trials aboard NOAA fishery research vessels, Pascagoula, MS.